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HAPLOPHRYNE HUDSONIUS

*A New Species; Description and Osteology**

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Preamble—Genus *HAPLOPHRYNE*

(Figures 2, 3, 4, 5)

It would not be unreasonable to establish a new genus for the Hudson Gorge fish which I am about to consider, but we know so little about individual and specific variation in the Ceratioidea that I chose a more conservative policy. Brauer in 1902 established the genus *Aceratias* for three species of fish. One of these was *A. mollis*. Regan, ten years later, removed *mollis* to a separate genus which he called *Haplophryne*. His original definition of this genus was "with depressible teeth and without nasal papilla." In 1926 he redefined *Haplophryne* as follows: "Sphenotic spines not prominent. Mouth rather small; teeth moderate. Illicium subcutaneous, small, with short stem and terminal bulb; a pore on upper surface of snout, at the margin of which the skin is attached to distal end of illicium. No barbel. Preopercular spine simple, concealed beneath the skin. Skin thin, loose, translucent, unpigmented."

Viewed through the translucent skin, the fish I have under consideration fits this generic definition, except that the reference to the cephalic pore should be expanded to include double, sessile bulbs outside the skin.

Before taking up in detail this new specimen from the Hudson Gorge, I will review the four individuals called *mollis* by Regan. This will show our present knowledge and indicate the extent of variation. Only when more material is available can these variations be catalogued with certainty as individual or specific.

The quartet of described specimens of *H. mollis* is as follows:

A—14 mm. long. Valdivia Expedition. Indian Ocean.
26° 3′ 6″ So. Lat.; 93° 43′ 7″ East Long. Depth 1203 fathoms.

B—32 mm. long. Dana Expedition.
25° 7′ N. Lat.; 19° 20′ West Long. South of the Canaries.

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COMPARISON OF FOUR SPECIMENS OF H. MOLLIS[1]

	(A) Valdivia	(B) Dana	(C) Terra Nova	(D) Stanford	Extremes of Variation
Dorsal and Anal rays	3	3	3	3	
Caudal rays	8	8	9	9	8–9
Pectoral rays	14–16	15	15	18	14–18
Depth to length	2.1	1.6	1.5	2.7	1.5–2.7
Head to length	2.5	1.9	1.7	2.4	1.7–2.5
Snout to head	3.6	3.3	4	?	3.3–4
Eye to head	5.5	9.2	5	7	5–9.2
Eye to snout	1.5	2.8	1.2	?	1.2-2.8
Mandible to head	2.6	1.7	3.5	1.5	1.5–3.5
Illicium	absent[2]	subdermal; opening into pore	rudimentary; subdermal	?	various
Anus position (lateral)	asymmetrical	symmetrical	symmetrical	?	sym. or asym.
Anus position (longitudinal)	mid-body	¾ back	⅗ back	?	½–¾ back
Cephalic spines	?	small sphenotics	?	2 strong supraorbitals	0-2
Rostral denticles	3, isolated	? premaxillary	?	?	0-3
Teeth, upper jaw	9	11	5	?	5–11
Teeth, lower jaw	13	11	6	14	6–14
Gape	to front of eye	to mid-eye	to front of eye	behind eye	In front to far back of eye
Eyes	telescopic	normal	normal	normal	normal–telescopic
Mouth	moderate horizontal	small oblique	small horizontal	large vertical	small–large vertical–horizontal
Branchiostegals	4	?	?	5	4–5

[1] This data is compiled both from printed descriptions and from drawings.
[2] Probably overlooked, owing to dermal opacity.

C—7 mm. long.[1] Terra Nova Expedition. New Zealand. Surface.

D—100 mm. long.[2] Stanford Expedition. Galapagos Islands. From stomach of Green Turtle.

The fifth column of the accompanying table shows the extraordinary range of variations, some of which must ultimately prove to be specific or generic. In a few instances the variation may be the result of distortional relaxation of the tissues, or confusion resulting from surface examination. I have avoided the latter difficulty in my own specimen by thoroughly clearing it and staining the skeleton with a vital bone stain.

Haplophryne hudsonius sp. nov.

Type number 7696: Hudson Gorge Station 114, T6. 39° 15′ N. Lat., 72°, 00′ W. Long. July 7, 1928. Taken in a metre net at a depth of 600 fathoms.

Field Characters: A small, white, balloon-skinned, elongate, ceratioid fish, with three large, curved rostral denticles; dorsal and anal three-rayed; double, minute, sessile, cephalic bulbs; anus sinistral, three-fourths toward tail.

Measurements of Type:

Standard length: 15 mm.
Head: 7.5 (in length 2)
Total depth: 6.6 (in length 2.2)
Body depth: 5.1
Total breadth: 5.7 (in length 2.6)
Body breadth: 4.3
Eye: 1.3 (in head 5.8)
(in interorbital 2)
Interorbital 2.7
Snout: 1.6 (in head 4.7)
Maxillary: 2.8 (in length 5.3)
Dorsal: 3 Anal: 3
Pectoral: 17
Caudal: 9 (2 upper, 3 lower simple)
Caudal length: 8.1
Snout to dorsal: 11.3
Snout to anus: 10:7
Ocular angle: 24° down[3]
Ocular divergence: 18° forward
Mouth angle: 12° up

The first thing we notice in the cleared specimen is the absolute hyalinity of the very thick, balloon-like casing of skin. The thickest portion of the fish is at mid-head, and from here the crown curves regularly and steeply downward to the mouth. Posteriorly the line of the back is almost a straight slope to the tail. The chin curves rapidly back to the end of the mandible, whence the contour is straight.

[1] I assume the given length of 10 mm. is total length.

[2] The given length of 27 mm. is, judged by all the other measurements, an original misprint for 100 mm.

[3] The angles were taken as soon as possible after death.

The superior contour of the actual body within the dermal envelope follows closely that of the outside, except that the profile of the skull from the supraoccipital to the premaxillary is flat rather than curved. So complete is this envelope that the tip of the jaw is the only spot where the skeleton contacts with the outside. The other points of penetration are the paired cephalic bulbs and the gill-openings, the anus and fin rays.

Although at first glance the dermal balloon appears perfectly homogeneous, yet in the course of manipulation an outer layer of epidermis peels almost completely away. This is of considerable thickness, and under low power shows innumerable, minute, needle-like spicules, giving, in some lights, a frosted or flocculent appearance. Under higher magnifications a great number of very small, rounded or oval figures are seen, but offer no clue as to whether they are vestiges of former scales.

In spite of the small size of this fish the skeleton is remarkably well ossified, the various skull and branchial elements, the vertebrae and fin rays showing an even, scarlet stain. In sharp contrast with this, the optic envelopes, the coelomic contents, and the pectoral and trunk muscles are differentiated as pale, translucent, orange tissues.

Whether the imperfectly ossified edges and ends of some of the bones represent solely a juvenile condition, or whether this is a permanently arrested phase due to unknown bathypelagic factors we do not as yet know. As Lütken says in writing of the skull of an adult Ceratias, "Le crâne a la même structure spongieuse ou fibro-lamelleuse que la colonne vertébrale, les os de l'épaule etc.; mais il y entre de plus un élément cartilagineux assez considérable, certaines parties du chondrocrâne primordial restant dans l'état primitif, soit sur les confins des os qui se sont formés a ses dépens, soit sous les ossifications parastotiques développées au-dessus d'elles ou dans leur portion périphérique."

The fact of the perfection of development, in spite of the diminutive size, of the illicium, and its elaborate musculature, also the quite undegenerate aspect of the almost wholly sub-cutaneous dorsals and anals, seem to suggest that the swollen dermal envelope is a larval or juvenile character. It may be useful as a buffer protection of sorts during the late stages of development, aiming toward such an adult form as *Dolopichthys*.

I have included in my brief review a few characters, such as the ray segmentation which may seem trivial, but until we know more about the comparative physiology of these deep sea fishes we cannot be sure of what is trivial or what is preeminently significant.

Cranium

The top of the cranium is not very unlike that of *Borophryne* as shown by Regan, but with the ethmoids much less in extent, with the interfrontal hiatus of a different shape, and the anterior half of the skull wider. The median hollow or groove shown so conspicuously in all the Ceratioid skulls of Regan is only slightly developed. Anteriorly it is distinguishable but disappears at the supra-occipital where the skull flattens out. Behind this the median line again shows a slight hollowing or furrowing between the two laterally prominent epiotics.

Looking down on the cranium, its junction with the vertebral column can clearly be made out between the two great masses of trunk muscles which sweep forward on each side of the neural arches to their attachment along the entire posterior aspect of the epiotics. The cone-like, concave facet of the basioccipital extends backward and obliquely upward to engage the corresponding portion of the first vertebral centrum. On each side of the foramen magnum two thin, wing-like projections from the exoccipital articulate with two from the first vertebra. The neural arch of this latter bone is broader than its posterior fellows, quite spineless, and instead of slanting backward it is directed forward, closely applied to the faintly ossified posterior cranial region. If this fish has nearly completed its calcification this is an interesting arrested phase, if not, the neural arch would in time have become wholly fused with the periphery of the foramen magnum.

The entire posterior upper surface of the cranium is formed by the large epiotics, which join medially and quite shut out the supra-occipital from the posterior outline. The supraoccipital is large and roughly circular, occupying the center of the cranium. On each side are large parietals, concave where they abut on the supraoccipital, widely rounded laterally over the sphenotics, and sending a small flattened spine back along the outer contour of the epiotics.

Returning again to the posterior edge of the cranium, the post-temporals show a broad condylar face for articulation with the supra-

cleithrum. They are roughly square in shape, extending forward along the sides of the cranium, and engaging the epiotics and the pterotics. The pterotics continue the lateral aspect forward, lying alongside the epiotics and parietals, and showing a pronounced articulation for the hyomandibular. The sphenotic forms the posterior half of the supra-orbital rim, and just posterior to the eyeball gives rise to a strong, outjutting lateral spine .7 mm. in length, sharp, slender and straight, which extends out beyond the circumference of the eye to the very surface of the cutaneous envelope.

The frontals are well separated, leaving a cartilaginous hiatus which is linear rather than (as is indicated in *Borophryne*) circular. Each constitutes a fourth of the supero-anterior border of the orbit; anteriorly the frontal curves down beneath the nasal tissue, ending in two sharp, lateral points connected by a deep, ossified bay. A ridge of bone runs from the center to each point, that to the outermost being much the stronger. Posteriorly the frontals touch the supraoccipital narrowly, and the parietals along a wide extent.

The prefrontals are distinguishable as two slender, hour-glass like bones, closely resembling the interhyals in shape. They extend from the region of the anterior end of the parasphenoid back to the inner, anterior fork of the frontal. The vomer is a transversely winged bone, broad-arrow-barb-like, extending across the anterior ends of the parasphenoid. The ethmoids are too transparent for clear definition.

Viewing the skull from the side, the strong, thin parasphenoid is seen rising well forward beneath the nasal tissue, and extending straight backward, visible through and exactly bisecting the translucent, pale brown sphere of the eyeball, and on back to the base of the skull. The prefrontals are dimly discernible through the mist of narial tissue. Back of and lateral to the suture of the premaxillaries is a small lachrymal.

Palato-Pterygoid Arcade

The hyomandibular is less strongly ossified than any of the bones with which it is associated, but it shows a broad superior surface, articulating with the pterotic and extending forward as far as the sphenotic. Directly below, a strong connection is made with the opercular condyle. The deeper cheek area is much more strongly muscled

than it is ossified, but a faint connection of the hyomandibular with an interhyal can be made out. No symplectic is visible.

The quadrato-angular articulation is by means of a delicate, wide, needle-fine, transverse condyle. From this point the tissue of the quadrate is stretched between three lines of strong radiating ridges, one upward and slightly forward to meet the palatine, a second up and somewhat backward which connects with the pterygoid, and a third obliquely back, passing beneath the preopercle.

The pterygoid shows ossification only as an irregular plate, twisted into three planes, and sending forward a long finger which meets the still more slender palatine.

Jaw Apparatus

The jaws are well ossified. The premaxillaries viewed from above are slightly separated at their suture, and show an abrupt height at this point. Laterally this height rapidly narrows to a flat, even-edged jaw rim extending well over the mandible and reaching almost to its supero-posterior angle. The maxillary can be distinguished as a thin rod of bone beginning at the point of narrowing of the premaxillaries and lying loosely along its upper edge.

Three large, curved, talon-like denticles arise out of the ethmoid cartilage, quite clear of the jaw, their roots close and showing a large area of ossified, anastomosing filaments. One denticle is median, while the other two have their tips rotated laterally. From the very front of the premaxillaries, close to their symphysis, two minute teeth project straight ahead. The rest of the rim of the upper jaws shows a few incipient teeth of very small size, irregularly placed. In front of the lower jaw are five pairs of strong teeth, the central pair straight and extending horizontally outward. The four lateral pairs are curved like the three superior teeth, but are smaller. When these are viewed from directly below the jaw, they are seen to be elevated well above and anterior to the bone, arranged along a line of cartilage. This seems to bring them into the same category of dermal denticles as the nostril trio.

Behind these ten teeth and along the anterior rim of the lower jaw are the real mandibular teeth. Four large, curved ones are seen

on each side of the middle line, forming a true second row of lower teeth.

The mandible has a very noticeable projection at the symphysis, directed downward. Posteriorly the jaw broadens rapidly and the distance from the superior to the inferior angles at the back is contained only 2.3 times in the entire mandible length. Half way back along the mandible occurs the fork of the dentary—both prongs extending almost to the posterior edge of the jaw. The articular fills in between the upper and lower arms and forms a deep, rounded bay of articulation for the condyle of the quadrate, halfway down the long, oblique, posterior aspect.

Opercular Bones

The opercle is a large, fish-tailed bone, presenting an anterior articulation with the hyomandibular. At the point of junction a strong but short spine rises upward and obliquely forward. From this point two strong ridges of bone diverge at right angles, one reaching up and back to and across the supracleithrum, and the other down and back, just bisecting the first branchiostegal. Between the ridges extends a thin lamina of bone, deeply incurved from the two points.

The preopercle is elongated, rather narrow, slightly angled—in fact very boomerang-like in outline, with a ridge of bone along the anterior edge. The upper end dies out insensibly over the hyomandibular, yet showing hardly any difference in plane; and the lower portion terminates near the angular, overlapping but quite distinct from the quadrate. The entire bone is flat and shows no trace of spines at any point.

The interopercle, viewed laterally, is a long, narrow sliver of bone, in appearance like a strong mid-rib to the expanded, leaf-like ceratohyal beneath. It lies midway between and parallel to the lower half of the preopercle and the heads of the second to fifth branchiostegals. It is slightly broader at the upper end, and is intimately connected with the junction of the interhyal and epihyal. The ossification of the interopercle ends about three-fourths of the way to the angular. For the last quarter, its course is outlined clearly in cartilage to the very point of the prominent angular condyle.

I can distinguish no trace of a subopercle.

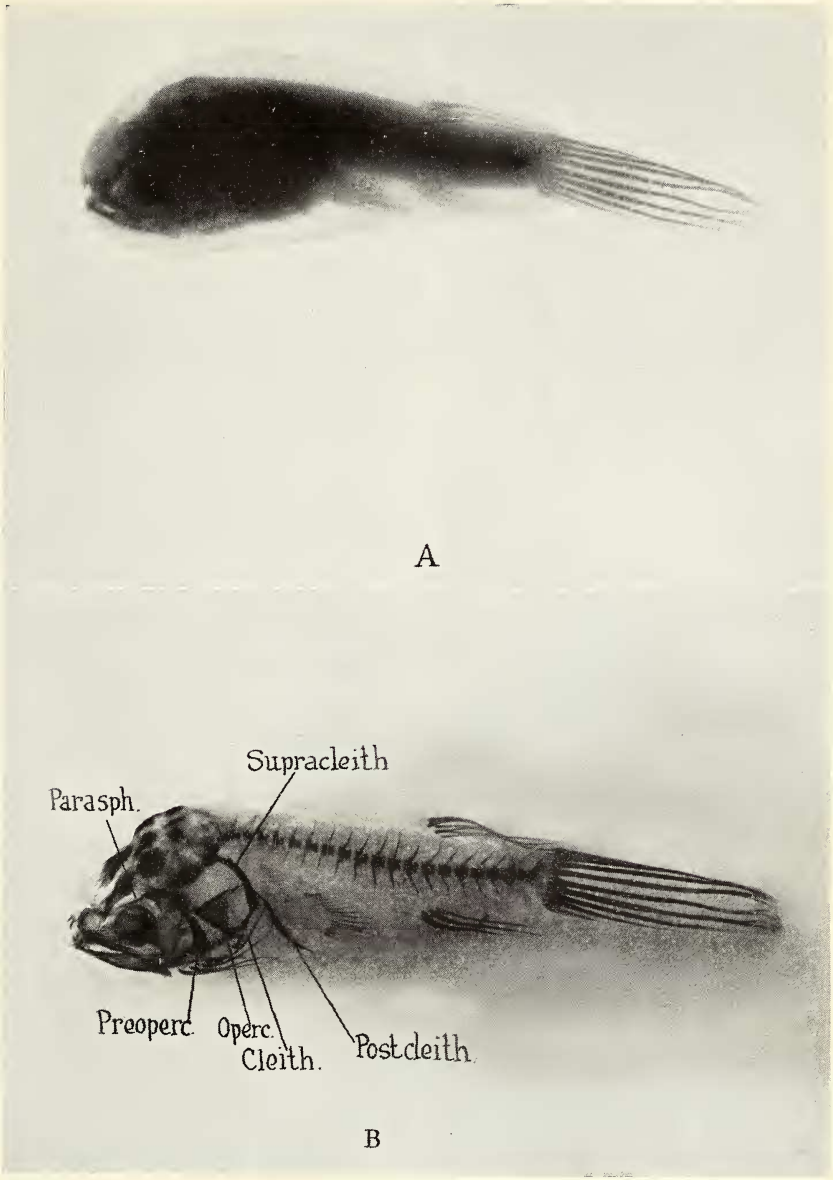

Fig. 2. HAPLOPHRYNE HUDSONIUS, sp. nov. A—Uncleared, as the fish came up in the net. B—Side view after clearing. Illustrations from unretouched photographs.

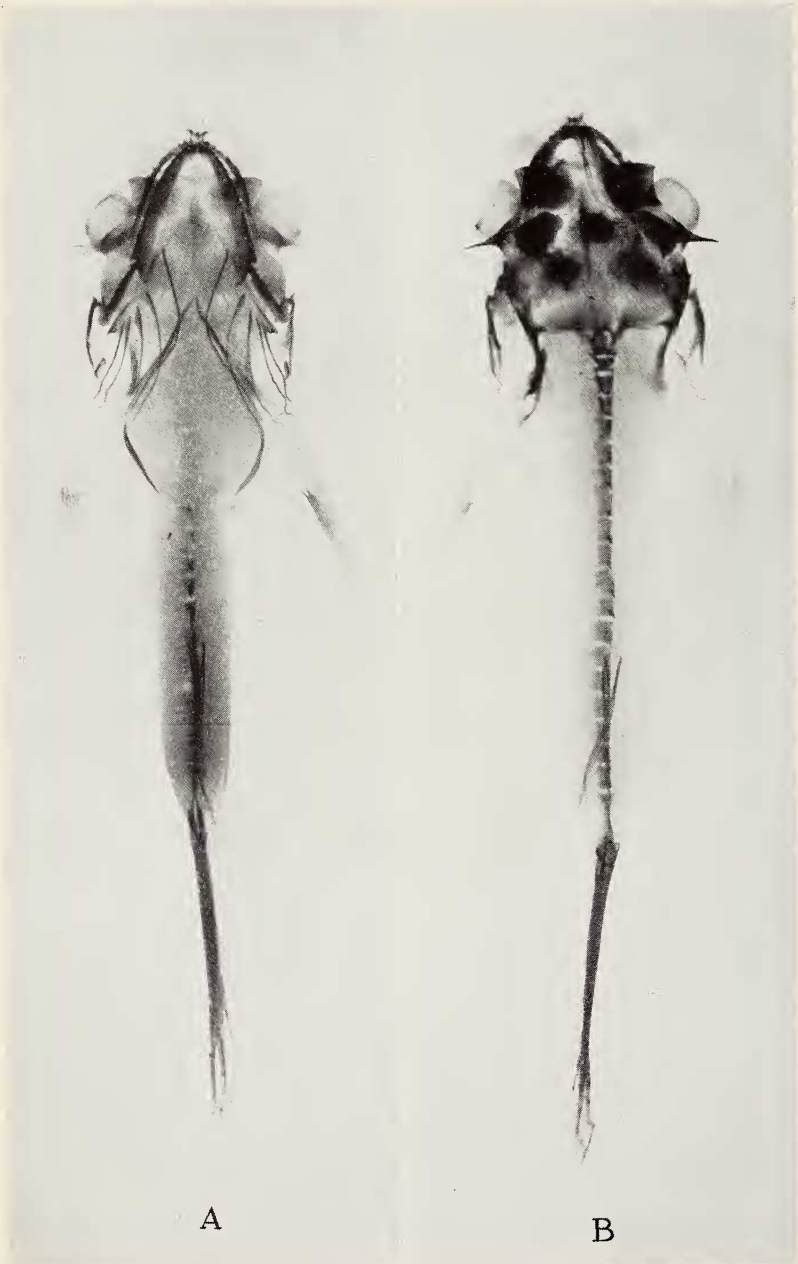

Fig. 3. HAPLOPHRYNE HUDSONIUS, sp. nov. A—Lower view of the whole fish. B—Top view of the whole fish. Illustrations from unretouched photographs.

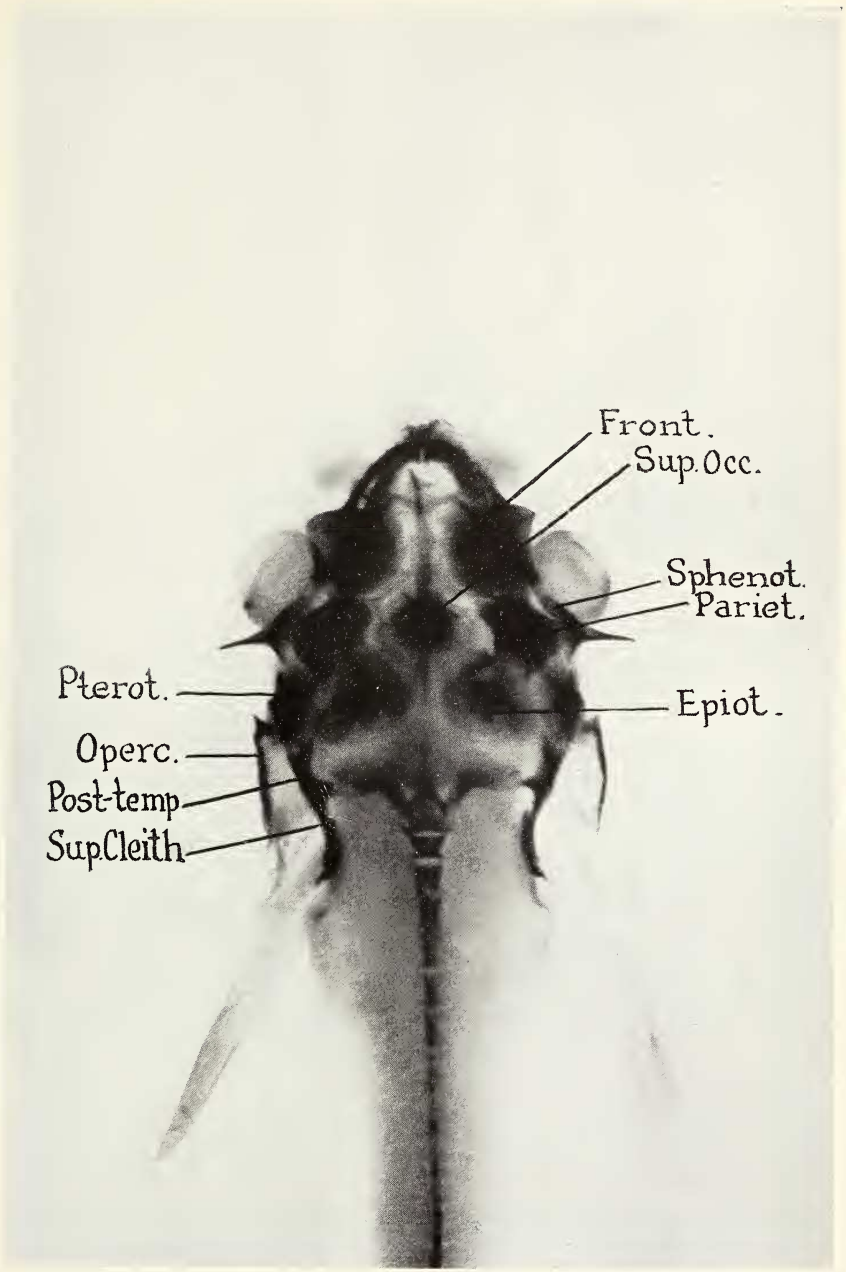

Fig 4. HAPLOPHRYNE HUDSONIUS, sp. nov. Top view of skull.

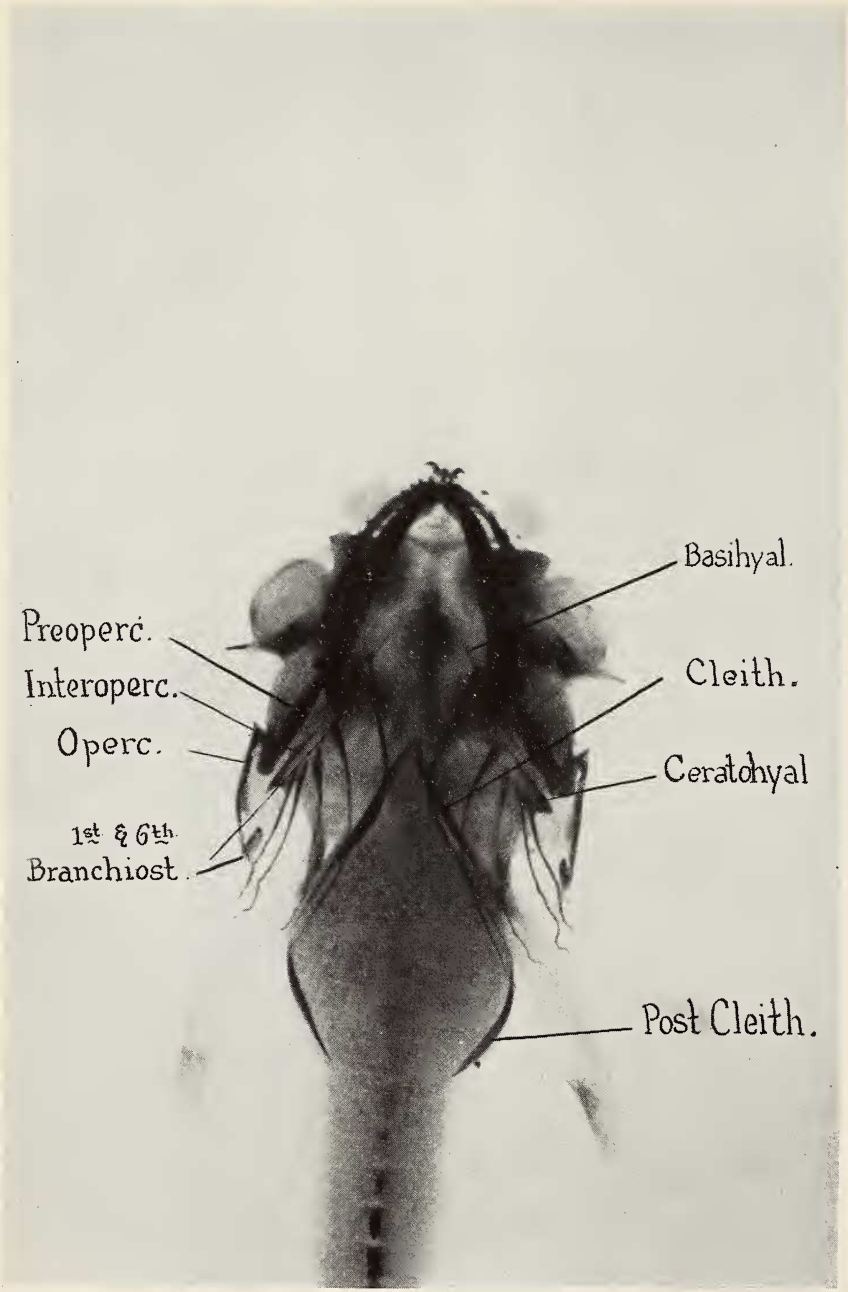

Fig. 5. HAPLOPHRYNE HUDSONIUS, sp. nov. Lower view of head. Illustration from an unretouched photograph.

Hyoid Arch

From the lower part of the hyomandibular arises the elongate, very slender, hour-glass shaped interhyal, extending obliquely down and backward, beneath the angle of the preopercle. Posteriorly it articulates at right angles with the epihyal. This is a very short bone and hardly to be differentiated from the long ceratohyal. Just beneath the quadrato-angular articulation the long basihyals arise and extend far forward, almost uniting on the mid-throat. These latter are more strongly ossified at the ends than in the center. No glosso or urohyals are distinguishable.

There are six branchiostegal rays.

The first branchiostegal is very long, and originates well forward on the basihyals. Curving inward and backward its attenuated tip reaches as far as those of the other branchiostegals. It is 4.6 mm. over all, and shows very little widening. None of the branchiostegals reaches as far back as the gill opening.

The second to fifth arise side by side from the lower leaf of the ceratohyal, their heads parallel with the rod-like interopercle.

The sixth (rearmost) arises from no visible bone or cartilage, from a point just ventral to the tip of the lower fork of the opercle, and extends up and across the junction of the cleithrum and supracleithrum. It is the shortest of all, being only 2 mm. in length. Like the succeeding ones it has a strong bony ridge along one side, and widens at the anterior end into a lacrosse-stick shape.

Branchial Arches

The gills show clearly through the bones of the side of the head, but no detail can be made out as to supporting structures. The gill openings are small, round (.16 mm. in diameter), and open at the vertical of the seventh vertebra.

Vertebral Column

The general direction of the column is a gentle rise headward of about 20° from the horizontal ventral surface of the fish, up to the first vertebra, which makes a sharp dip forward to the foramen mag-

num. Or if we consider the line of the vertebrae as horizontal, then the first vertebra and the head are deflected 40°. The chief characteristic is the great linear height of the neural and haemal arches and their unusually vertical disposition.

There are twenty vertebrae, of which twelve are trunk and eight caudal. The neurapophyses of the anterior vertebrae are wide and tall, forming a triangular arch of bone, very slightly thickened at the summit and ending in a short point. Posteriorly the arches increase considerably in height, but become very narrow, the canals consecutively lessened by the filling in of bony tissue from the apex of the arch. As we approach the tail vertebrae we find a relatively small perforation while each neural spine has lengthened into a sort of wavy, vertical osseous pennant. The most anterior neurapophysis is directed forward, but the succeeding ones are vertical up to the thirteenth or the first caudal, when they acquire a backward slant.

Haemapophyses are wholly lacking on the first two vertebrae, while on the succeeding three they are downward pointing spikes. From the sixth on the haemapophyses duplicate the neural arches, lacking only the extreme length of the spines with their wavy points. The haemal arches of the trunk are more or less vertical, but at the thirteenth vertebra they assume a decided backward slant, more pronounced than that of the neural arches.

Zygapophyses are found on the first to seventh vertebrae in the form of long, slender spines, directed forward and upward, almost touching the central part of the neural arch in front, and of no articular value whatever. On the first vertebra these are provided with wing-like expansions which articulate with processes from the exoccipitals.

There is no trace of ribs.

Caudal Fin and End of Vertebral Column

The next to the last vertebra has a normal perforated neural and haemal arch, but the spines themselves are prolonged to twice their usual length, and flattened out posteriorly into long, club-shaped expanses, which end respectively at the summit and the base of the fan-shaped tail support. Just above the reduced canals in this penultimate vertebra, two narrow, leaf-shaped projections arise from near the

base of the neural and haemal arches, and extend straight out to the full length of the preceding apophyses.

The last vertebra consists of a normally shaped anterior half-centrum, giving rise to a slightly undulatory urostyle, which lies in high relief along the upper anterior face of the caudal support, reaching half-way to its summit. At the base of the urostyle there is a round perforation from side to side, enclosed by the ascending boundary of the lower part of the basal tail bone.

Although the tail support is well ossified, I can make out no division into epi- or hypurals. This fan shaped bone appears quite homogeneous.

There are nine caudal rays and the only hint of a division of the basal bony support is in the very slightly wider interval between the four upper and the five lower rays. The split bases of all the rays overlap the basal support as much as .4 mm. while the base of the uppermost ray projects even beyond its anterior border. The bases are not stellate like those of the dorsal and anal rays, but end in an elongate, blunt, finger-like projection.

The thick body envelope extends a little beyond half the length of the rays. The uppermost and the two lower are short and extend less than half the total length of the others. These central six are ex-cutaneous and functional, and are equal in length—7.5 mm. over all. The central four are branched at the tips, and all are distally furnished with an expanded, leaf-like, colorless blade of tissue. Counting down from the uppermost long rays the sequence of segmentation is as follows:

2nd ray	8			segments
3rd ray	10	plus branch	4	"
4th ray	12	" "	4	"
5th ray	13	" "	4	"
6th ray	11	" "	2	"
7th ray	10			

The three outermost short rays have only one or two indistinct segments.

Dorsal Fin

The three rays of the dorsal fin begin far back on the body, four-fifths of the distance from the snout to the tail. The bases of the three

rays arise so close together and so obliquely that, viewed laterally, all are actually between the verticals of the neural spines of the 13th and 14th vertebrae. The base of the third ray rests on the trunk proper, while that of the first is raised obliquely upward so that it is halfway between the body of the fish and the external surface of the cutaneous envelope. There is no hint of bony supports, merely the short, oblique lateral muscle bands. In front, a longer muscle, the levator, extends almost to the tip of the 12th neural spine.

Like all the other fin rays, each of these dorsals arises from two bases, placed laterally well apart. In the first dorsal this width is .32 mm. This bilateral fission persists throughout much of the length of the ray, although a short distance from its proximal end the space becomes filled with transparent tissue. Each ray half is flat, the base is slightly expanded and presents a three-pointed face for the attachment of the muscle.

The direction of the rays is very obliquely backward, almost paralleling the contour of the trunk. They are exceedingly flexible and wavy. Close to the tips of the rays, just before they protrude from the skin each show cross segments, typical of soft fin rays in general. There is only one in the first and longest ray, two segments in the second, and three in the lowermost or third. Distally the rays protrude from the skin, each fine terminal point showing osseous structure, and enveloped in a flat, vertical leaf of clear tissue. The total length of the first ray is 4 mm., of which .7 mm. extends above the outer skin. The tips of the dorsal rays reach almost a millimetre beyond the base of the outer caudal ray.

Anal Fin

The anal fin is identical with the dorsal both in relative longitudinal position, number of elements and in general structure.

Pectoral Girdle and Fin

The shoulder girdle may be taken to begin at the junction of the posttemporal and the supracleithrum. This latter bone is long and slender and curves down and back from the postero-lateral rim of the cranium to midway between the posterior spines of the opercle.